



Fig. 6. a) In-plane optical force F_{xz} for a particle with radius of 25 nm. b) Optical potential map for the particle. The white line shows the top of the slot.

4. Conclusion

We have proposed a new PhC lattice for optical trapping of two-dimensional arrays of nanoparticles. Our structure is created by using the 2D Suzuki-phase PhC lattice as a base and introducing a slot into each unit cell to localize the electromagnetic field. Optimizing the slot dimensions increases the Q factor of the resonance by orders of magnitude. Optical power values as low as $27 \mu\text{W}$ per unit cell are predicted for trapping of 25 nm radius beads, a reduction of power by about 40 times relative to our previous work. Once the particle is on the slot, optical power of $3 \mu\text{W}$ per unit cell is required for the stable optical trapping. Our Slot-Suzuki-Phase lattice is a promising candidate for carrying out light-assisted templated self assembly processes.

The low power requirements for trapping suggest to use of active materials for this purpose. Slot photonic crystal microcavity lasers have been demonstrated with output optical power as high as $150 \mu\text{W}$, and some evidence suggests possible optical trapping effects in such structures [28, 29]. The Slot-Suzuki-phase structure we propose here provides a way of effectively combining multiple slot PhC microcavities into a high-Q structure with extended area. Further improvement of the design can be achieved by band engineering techniques, as well as by combining the photonic crystal with a bottom Bragg reflector [30, 31]. In such a device, we expect that the laser may self-adapt, adjusting its own lasing wavelength in response to the resonance shift induced by trapped particles.

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